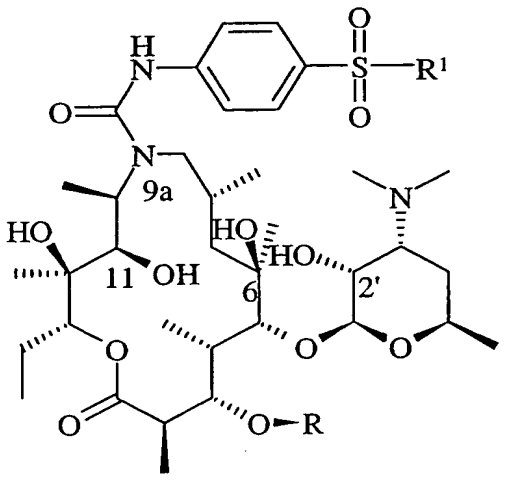
Substituted 9a-N-{N'-[4-(sulfonyl)phenylcarbamoyl]} derivatives of 9--deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O--desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A

Technical Field

Int. Cl. C07H17/08, A61K31/71

Technical problem

The present invention relates to substituted 9a-N-{N'-[4-(sulfonyl)phenylcarbamoyl]} derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl--9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A, novel semisynthetic macrolide antibiotics of the azalide series having antibacterial activity of the general formula **1**



1

wherein R represents H or cladinosyl moiety, and R^1 represents chloro, amino, phenylamino, 2-pyridylamino, 3,4-dimethyl-5-isoxazolylamino and 5-methyl-3--isoxasolylamino group, to pharmaceutically acceptable addition salts there of with

inorganic or organic acids, to a process for the preparation of the pharmaceutical compositions as well as to the use of pharmaceutical compositions obtained in the treatment of bacterial infections.

Prior Art

Erithromycin A is a macrolide antibiotic , whose structure is characterized by 14--membered macrolactone ring having carbonyl group in C-9 position. It was found by McGuire in 1952 [*Antibiot. Chemother.*, **2** (1952) 281] and for over 50 years it has been considered as a reliable and effective antimicrobial agent in the treatment of diseases caused by Gram-positive and some Gram-negative microorganisms. However, in an acidic medium it is easily converted into anhydroerythromycin A, an inactiv C-6/C-12 metabolite of a spiroketal structure [P. Kurath et al., *Experientia* **27** (1971) 362].It is well-known that spirocyclisation of aglycone ring of erythromycin A is successfully inhibited by a chemical transformation of C-9 ketones or hydroxy groups in C-6 and/or C-12 position. By the oximation of C-9 ketones [S. Đokić et al., *Tetrahedron Lett.* **1967**: 1945] and by subsequently modifying the obtained 9(E)-oxime into 9-[O-(2--methoxyethoxy)methyloxime] erithromycin A (ROXITHROMYCIN) [G. S. Ambrieres, Fr. Pat. 2,473,525, 1981] or 9(S)-erithromycylamine [R. S. Egan et al., *J. Org. Chem.* **39** (1974) 2492] or a more complex oxazine derivative thereof, 9-deoxo-11--deoxy-9,11-{imino[2-(2-methoxyethoxyethylidene]-oxy}-9(S)-erythromycin A (DIRITHROMYCIN) [P. Lugar i sur., *J. Crist. Mol. Struct.* **9** (1979) 329], novel semisynthetic macrolides were synthetised, whose basic characteristic, in addition to a greater stability in an acidic medium, is a better pharmacokinetics and a long half-time with regard to the parent antibiotic erythromycin A. In a third way for modifying C-9 ketones use is made of Beckmann rearrangement of 9(E)-oxime and of a reduction of the obtained imino ether (G. Kobrehel i sur., U.S. Pat. 4,328,334, 1982.) into 11-aza-10--deoxo-10-dihydroerythromycin A (9-deoxo-9a-aza-9a-homoerythromycin A) under broadening the 14-member ketolactone ring into a 15-member azalactone ring. By reductive N-methylation of 9a-amino group according to Eschweiler-Clark process (G. Kobrehel et al., BE Pat. 892,397, 1982.) or by a preliminary protection of amino group by means of conversion into the corresponding N-oxides and then by alkylation and

reduction [G. M. Bright et al., U.S. Pat., 4,474,768, 1984.] N-methyl-11-aza-10-deoxo--10-dihydroerythromycin A (9-deoxo-9a-methyl-9a-aza-9a-homoerithromycin A, AZITHROMYCIN) was synthetized, a prototype of azalide antibiotics, which, in addition to a broad antimicrobial spectrum including Gram-negative bacteria and intrcellular microorganisms, are characterized by a specific mechanism of transport to the application site, a long biological half-time and a short therapy period. In EP A 0316128 (G. M. Bright et al.) novel 9a-allyl and 9a-propargyl derivatives of 9-deoxo-9a-aza-9a-homoerythromycin A are disclosed and in U.S. Pat. 4,492,688, 1/1985 (Bright G. M.) the synthesis and the antibactertial activity of the corresponding cyclic ethers are disclosed. In the J. Antibiotics **46** (1993) 1239 (G. Kobrehel et al.) there are further disclosed the syntesis and the activity spectrum of novel 9-deoxo-9a-aza-11--deoxy-9a-homoerythromycin A 9a,11-cyclic carbamates and O-methyl derivatives thereof.

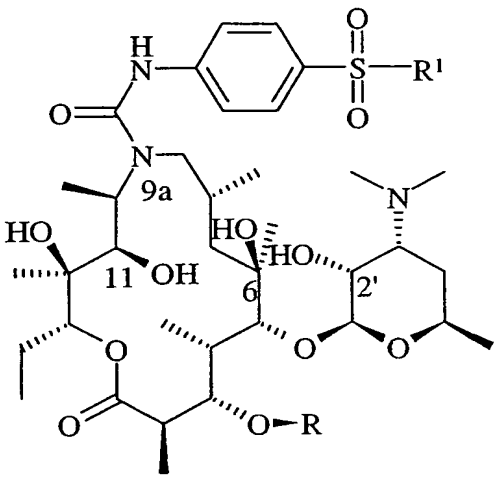
According to the known and established Prior Art, 9a-N-{N'-[4--(sulfonyl)phenylcarbamoyl]} derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A and pharmaceutically acceptable addition salts thereof with inorganic or organic acids, a process for the preparation thereof as well as the preparation methods and use a pharmaceutical preparations have not been disclosed as yet.

It has been found and it is object of the present invention that substituted 9a-N-{N'-[4-(sulfonyl)phenylcarbamoyl]} derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A, novel semisynthetic macrolide antibiotics of the azalide series and pharmaceutically acceptable addition salts thereof with inorganic or organic acids may be prepared by reacting ammonia or substituted amine with 9a-N-[N'-[4-sulfonylphenyl)carbamoyl] derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl--9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A which are obtained by reacting of -9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl-9-deoxo-9--dihydro-9a-aza-9a-homoerithronolide A with 4-(chlorosulfonyl)phenylisocyanate and optionally by reacting the obtained 9a-N-{N'-[4-(sulfonyl)phenyl]carbamoyl}

derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl--9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A with inorganic and organic acids.

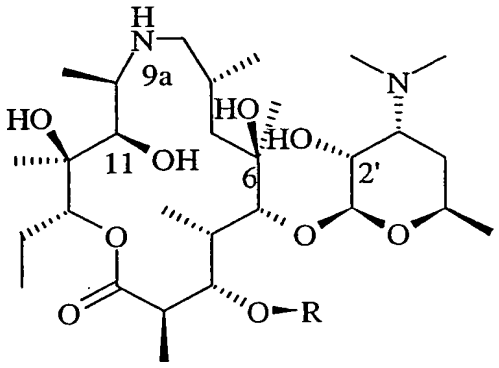
Technical Solution

It has been found that novel substituted 9a-N-{N'-[4-(sulfonyl)phenylcarbamoyl]} derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl--9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A of the general formula **1**, wherein R represents H or cladinosyl group and R^1 represents chloro group,



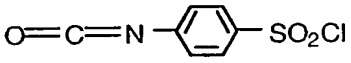
1

may be prepared by reacting 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5--O-desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A of the general formula **2**,



2

wherein R represents H or cladinosyl group, with 4-(chlorosulfonyl)phenylisocyanate formula **3**,



3

after that the compounds of general formula **1** were obtained, in which R has previous meaning, and R^1 represents Cl, by reaction of the compounds general formula **1** respectively, wherein R represents H or cladinosyl group and R^1 represents Cl, with ammonia or substituted amins general formula **4**, wherein R^2 represents H, phenyl group, 2-pyridyl group, 3,4-dimethyl-5-isoxazolyl group or 5-methyl-3-isoxazolyl group,

$$R^2\text{-}NH_2$$

4

in toluene, xylene or some other aprotic solvent, at a temperature of 0°C to 110°C.

Pharmaceutically acceptable acid addition salts which also represents an object of the present invention, were obtained by reaction of substituted 9a-N-{N'-[4--(sulfonyl)phenylcarbamoyl]} derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A with an at least equimolar amount of the corresponding inorganic or organic acid such as hydrochloric acid, hydroiodic acid, sulfuric acid, phosphoric acid, acetic acid, trifluoroacetic acid, propionic acid, benzoic acid, benzene sulfonic acid, metane sulfonic

acid, lauryl sulfonic acid, stearic acid, palmitic acid, succinic acid, ethylsuccinic acid, lactobionic acid, oxalic acid, salicylic acid and similiar acids, in a solvent inert to the reaction. Addition salts are isolated by evaporating the solvent or, alternatively, by filtration after a spontaneous precipitation or a precipitation by the addition of a non-polar cosolvent.

Substituted 9a-N-{N'-[4-(sulfonyl)phenylcarbamoyl]} derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithro- nolide A of the general formula **1** and pharmaceutically acceptable addition salts with inotganic or organic acids thereof possess an antibacterial activity *in vitro*.

Minimal inhibitory concentration (MIC) is defined as the concentration which shows 90% growth inhibition, and was determinated by broth dilution methods according to National Committe for Clinical Laboratory Standards (NCCLS, M7-A2) protocols. Final concentration of test substances were in range from 64 to 0.125 μg/ml. MIC levels for all compound were determinated on panel of susceptible and resistant Gram positive bacterial strains (*S. aureus, S. pneumoniae and S. pyogenes*) and on Gram negative strains (*E. coli, H. influenzae, E. faecalis, M. catarrhalis*).

Test substances from Example 3 to 7 were active on susceptible strains of *S. pyogenes* (MIC 2 to 8 μg/ml), and on susceptible strains on *S. pneumoniae* (MIC 0.5 to 8 μg/ml). Substances from Example 3 and 4 showed showed strong antimicrobial activities on *S. pyogenes* iMLS resistante strain (MIC 2 μg/ml).

The obtained results for substances from Example 3 to 7 expressed as MIC in mg/ml suggest a potentional use thereof as sterilization agents of e.g. rooms and medical instruments and as industrial microbial agents e. g. for the protection of wall and wooden coatings.

Process for the preparation of 9a-N-{N'-[4-(sulfonyl)phenyl)carbamoyl} derivatives of 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 5-O-desozaminyl-9-deoxo-9--dihydro-9a-aza-9a-homoerithronolide A of this invention is illustrated by the following Examples which should in no way be construed as a limitation of the scope thereof.

Example 1

9-Deoxo-9-dihydro-9a-N-{[4-(chlorosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithromycin A

A mixture of 1.35 g (1.84 mmol) 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 0.40 (1.84 mmol) 4-(chlorosulfonyl)phenylisocyanate and 30 ml dry toluene was stirred 1 hour at the temperature 0°-5°C. The reaction mixture was evaporated at reduced pressure to dryness to give crude 9-deoxo-9-dihydro-9a-N-{[4-(chlorosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithromycin A. The pure product was obtained, where from by chromatography the crude product on a sillica gel column using solvent methylene chloride.

MS(ES^+) m/z = 794.

Example 2

5-O-Desosaminyl-9-deoxo-9-dihydro-9a-N-{[4-(chlorosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithronolide A

Analogously to the process disclosed in Example 1, from 1.95 g (2.0 mmol) 5-O-desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A and 0.43 g (2.0 mmol) 4-(chlorosulfonyl)phenylisocyanate in 30 ml dry toluene crude product was obtained, wherefrom by chromatography on sillica gel column using methylene chloride as a solvent. Pure 5-O-desosaminyl-9-deoxo-9-dihydro-9a-N-{[4-(chlorosulfonyl)phenyl]-carbamoyl}-9a-aza-9a-homoerithronolide A was obtained.

MS (ES+)m/z = 794.

Example 3

9-Deoxo-9-dihydro-9a-N-{[4-(aminosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithromycin A

The solution of 1.35 g (1.84 mmol) 9-deoxo-9-dihydro-9a-aza-9a-homoerithromycin A and 0.4 g (1.84 mmol) 4-(chlorosulfonyl)phenyl isocyanate in 30 ml dry toluene was

stirred about 1.0 hour at the temperature 0°- 5°C. In the reaction mixture 5.0 ml (4.55 g; 61.5 mmol) 23 % water solution of ammonia was added and the reaction mixture was stirred about 30 minutes at room temperature. The crude product was filtered, wherefrom by column chromatography on sillica gel using solvent system methylen-chloride : methanol = 9 : 1. Pure 9-deoxo-9-dihydro-9a-N-{[4-(aminosulfonyl)phenyl]-carbamoyl}-9a-aza-9a-homoerithromycin A was obtained.

IR (KBr)/cm^{-1} = 1727, 1638, 1593, 1552, 1126, 1013.

^1H NMR (500 MHz; $CDCl_3/\delta$) = 4.41 (1H, H-1'), 4.76 (1H, H-1"), 4.00 (1H, H-3), 3.41 (1H, H-5), 3.20 (3H, 3"-OCH_3), 2.89 (1H, 4"), 2.50 (6H, 3'-N'$(CH_3)_2$), 2.26 (1H, H-2"a), 1.51 (1H, H-2"b), 1.29 (1H, H-8), 0.96 (3H, 10-CH_3), 0.89 (3H 4-CH_3), 0.80 (3H, H-15).

^{13}C NMR (500 MHz; $CDCl_3/\delta$) = 175.6 (C-1), 155.5 (9a-NCONH), 101.9 (C-1'), 95.2 (C-1"), 84.1 (C-5), 78.3 (C-3), 48.8 (3"-OCH_3), 44.5 (C-2), 27.6 (C-8), 19.9 (8-CH_3), 9.2 (10-CH_3), 11.1 (C-15).

MS (ES^+) m/z (%) = 933.

Example 4

9-Deoxo-9-dihydro-9a-N-{N'-[4-(phenylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a--homoerithromycin A

Analogously to the process disclosed in Example 3, from 1,35 g (1,84 mmol) 9-deoxo--9-dihydro-9a-aza-9a-homoerithromycin A, and 0,4 g (1,84 mmol) 4--(chlorosulfonyl)phenyl isocyanate, 1,0 ml (11,0 mmol) aniline in 30 ml dry toluene 0,8 g pure 9-deoxo-9-dihydro-9a-N-{N'-[4-(aminosulfonyl)phenyl]carbamoyl}-9a-aza-9a--homoerithromycin A was obtained with following spectral data.

IR (KBr)/cm^{-1} = 1727, 1638, 1593, 1552, 1126, 1013.

^{1}H NMR (500 MHz; CDCl3/δ) = 4.45 (1H, H-1'), 4.76 (1H, H-1"), 4.01 (1H, H-3), 3.38 (1H, H-5), 3.22 (3H, 3"-OCH_3), 2.90 (1H, 4"), 2.50 (6H, 3'-N'$(CH_3)_2$), 2.26 (1H, H-2"a), 1.52 (1H, H-2"b), 1.27 (1H, H-8), 0.90 (3H, 10-CH_3), 0.89 (3H 4-CH_3), 0.79 (3H, H-15).

^{13}C NMR (500 MHz; CDCl3/δ) = 179.0 (C-1), 155 (9a-NCONH), 103.8 (C-1'), 95.8 (C-1"), 84.7(C-5), 79.0 (C-3), 50.0 (3"-OCH_3), 46.5 (C-2), 27.9 (C-8), 20.4 (8-CH_3), 9.2 (10-CH_3), 11.3 (C-15).

MS (ES^+) m/z (%) = 1009.

Example 5

9-Deoxo-9-dihydro-9a-N-{N'-[4-(2-pyridylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithromycin A

Analogously to the process disclosed in Example 3, from 1.35 g (1.84 mmol) 9-deoxo--9-dihydro-9a-aza-9a-homoerithromycin A, 0.4 g (1.84 mmol) 4-(chlorosulfonyl)phenyl isocyanate and 0.70 g (5.2 mmol) 2-aminopyridine in 30 ml dry toluene 0.5 g pure 9--deoxo-9-dihydro-9a-N-{N'-[4-(2-pyridylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a--homoerithromycin A was obtained with following spectral data.

IR (KBr)/cm^{-1} = 1727, 1638, 1593, 1552, 1126, 1013.

^{1}H NMR (500 MHz; $CDCl_3$/δ) = 4.41 (1H, H-1'), 4.75 (1H, H-1"), 4.00 (1H, H-3), 3.38 (1H, H-5), 3.21 (3H, 3"-OCH_3), 2.89 (1H, 4"), 2.50 (6H, 3'-N'$(CH_3)_2$), 2.27 (1H, H-2"a), 1.48 (1H, H-2"b), 1.27 (1H, H-8), 0.89 (3H, 10-CH_3), 0.88 (3H 4-CH_3), 0.79 (3H, H-15).

^{13}C NMR (500 MHz; $CDCl_3$/δ) = 175.6 (C-1), 155.4 (9a-NCONH), 101.9 (C-1'), 95.1 (C-1"), 84.0 (C-5), 78.1 (C-3), 48.8 (3"-OCH_3), 46.5 (C-2), 27.6 (C-8), 19.9 (8-CH_3), 9.1 (10-CH_3), 11.1 (C-15).

MS (ES^+) m/z (%) = 1014.

Example 6

9-Deoxo-9-dihydro-9a-N-{N'-[4-(3,4-dimethyl-5-isoxazolylaminosulfonyl)phenyl]-carbamoyl}-9a-aza-9a-homoerithromycin A

Analogously to the process disclosed in Example 3, from 1.35 g (1.84 mmol) 9-deoxo--9-dihydro-9a-aza-9a-homoerithromycin A, 0.4 g (1.84 mmol) 4-(chlorosulfonyl)phenyl isocyanate and 0.41 g (3.67 mmol) 5-amino-3,4-dimethylisoxazole in 30 ml dry toluene 1.5 g pure 9-deoxo-9-dihydro-9a-N-{N'-[4-(3,4-dimethyl-5-isoxazolylaminosulfonyl)-phenyl]carbamoyl}-9a-aza-9a-homoerithromycin A was obtained.
MS (ES^+) m/z (%) =1028.

Example 7

9-Deoxo-9-dihydro-9a-N-{N'-[4-(5-methyl-3-isoxazolylaminosulfonyl)phenyl]-carbamoyl}-9a-aza-9a-homoerithromycin A

Analogously to the process disclosed in Example 3, from 1.35 g (1.84 mmol) 9-deoxo--9-dihydro-9a-aza-9a-homoerithromycin A, 0.4 g (1.84 mmol) 4-(chlorosulfonyl)phenyl isocyanate and 0.36 g (3.67 mmol) 3-amino-5-methylisoxazole in 30 ml dry toluene 0.40 g pure 9-deoxo-9-dihydro-9a-N-{N'-[4-(5-methyl-3-isoxazolylaminosulfonyl)-phenyl]carbamoyl}-9a-aza-9a-homoerithromycin A was obtained with following spectral data.

^1H NMR (500 MHz; $CDCl_3/\delta$) = 4.42 (1H, H-1'), 4.75 (1H, H-1"), 4.01 (1H, H-3), 3.39 (1H, H-5), 3.20 (3H, 3"-OCH_3), 2.89 (1H, 4"), 2.50 (6H, 3'-N'$(CH_3)_2$), 2.24 (1H, H-2"a), 1.48 (1H, H-2"b), 1.28 (1H, H-8), 0.90 (3H, 10-CH_3), 0.87 (3H 4-CH_3), 0.79 (3H, H-15).

^{13}C NMR (500 MHz; $CDCl_3/\delta$) = 175.8 (C-1), 155.6 (9a-NCONH), 101.7 (C-1'), 95.8 (C-1"), 84.0 (C-5), 78.3 (C-3), 48.9 (3"-OCH_3), 45 (C-2), 27.8 (C-8), 20.2 (8-CH_3), 9 (10-CH_3), 11.3 (C-15).

MS (ES^+) m/z (%) = 1014.

Example 8

5-*O*-Desosaminyl-9-deoxo-9-dihydro-9a-N-[4-(aminosulfonylphenyl)carbamoyl]-9a--aza-9a-homoerithronolide A

Analogously to the process disclosed in Example 3, from 1.15 g (2.0 mmol) 5-*O*--desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A, 0.43 g (2.0 mmol) 4--(chlorosulfonyl)phenyl isocyanate and 5.0 ml (4.55 g; 61.5 mmol) 23 % water solution of ammonia in 30 ml xylene 0.60 g pure 5-*O*-desosaminyl-9-deoxo-9-dihydro-9a-N-[4--(aminosulfonylphenyl)carbamoyl]-9a-aza-9a-homoerithronolide A was obtained with following spectral data.

^{1}H NMR (500 MHz; piridin/δ) = 8.16, 7.93, 7.93, 7.5 (1H, fenilni), 5.60 (1H, H-13) 5.1 (1H, H-1'), 4.41 (1H, H-5) 4.30 (1H, H-3), 3.61 (1H, H-5'), 3.49 (1H, H-2'), 3.02 (1H, H-2), 2.61 (1H, H-3'), 2.21 (6H, 3'-$N(CH_3)_2$), 2.36 (1H, H-14a), 1.70 (1H, H-4'a), 1.87 (1H, H-14b), 1.69 (1H, H-4) 1.52 (1H, H-4'b), 1.58 (3H, 2-CH_3), 1.01 (3H, H-15).

^{13}C NMR (500 MHz; piridin/δ) =178 (C-1), 156.7 (NHCONH), 144.8, (fenil.), 133.2 (fenil.), 131.5, 129.3, 127.6, 115.3, (CH, fenil.), 103.3 (C-1'), 75.0 (C-13) 75.4 (C-3), 69.9 (C-5'), 69.2 (C-2') 68.0 (C-5), 65.4 (C-3') 45.6 (C-2), 40.3 (3'-$N(CH_3)_2$), 39.1 (C-4), 23.2 (C-14), 29.2 (C-4'), 16.7 (2-CH_3), 11.4 (C-15).

MS (ES^+) m/z (%) = 775.

Example 9

5-*O*-Desosaminyl-9-deoxo-9-dihydro-9a-N-{N'-[4-(phenylaminosulfonyl)phenyl]-carbamoyl}-9a-aza-9a-homoerithronolide A

Analogously to the process disclosed in Example 3, from 1.15 g (2.0 mmol) 5-*O*--desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A, 0.43 g (2.0 mmol) 4--(chlorosulfonyl)phenyl isocyanate and 0.4 ml (0.419 g, 4.4 mmol) aniline in 30 ml dry toluene 0.70 g pure 5-*O*-desosaminyl-9-deoxo-9-dihydro-9a-N-{N'-[4-(phenylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithronolide A was obtained with following spectral data.

^{1}H NMR (500 MHz; $CDCl_3/\delta$) = 4.35 (1H, H-1'), 3.86 (1H, H-3), 3.57 (1H, H-5'), 3.31 (1H, H-2'), 2.67 (1H, H-2), 2.5 (1H, H-3'), 2.30 (6H, 3'-$N(CH_3)_2$), 1.96 (1H, H-14a), 1.70 (1H, H-4'a), 1.56 (1H, H-14b), 1.30 (1H, H-4'b), 0.93 (3H, H-15).

^{13}C NMR (500 MHz; $CDCl_3/\delta$) =175.8 (C-1), 105.3 (C-1'), 75.4 (C-3), 69.8 (C-5'), 68.9 (C-2') 64.6 (C-3') 44.7 (C-2), 39.6 (3'-$N(CH_3)_2$), 20.9 (C-14), 29.8 (C-4'), 10.4 (C-15).

MS (ES^+) m/z (%) = 851.

Example 10

5-*O*-Desosaminyl-9-deoxo-9-dihydro-9a-N-{N'-[4-(2-pyridylaminosulfonyl)phenyl]-carbamoyl}-9a-aza-9a-homoerithronolide A

Analogously to the process disclosed in Example 3, from 1.15 g (2.0 mmol) 5-*O*--desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A, 0.43 g (2.0 mmol) 4--(chlorosulfonyl)phenyl isocyanate and 0.4 g (4.2 mmol) 2-aminopyridine in 30 ml dry toluene 0.80 g pure 5-*O*-desosaminyl-9-deoxo-9-dihydro-9a-N-{N'-[4-(2-pyridylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithronolide A was obtained with following spectral data.

^{1}H NMR (500 MHz; $CDCl_3/\delta$) = 8.30, 7.64 7.38, 7.64 (1H, aminopiridin), 4.34 (1H, H-1'), 3.84 (1H, H-3), 3.58 (1H, H-5'), 3.31 (1H, H-2'), 2.63 (1H, H-2), 2.6 (1H, H-3'), 2.29 (6H, 3'-$N(CH_3)_2$), 1.94 (1H, H-14a), 1.71 (1H, H-4'a), 1.55 (1H, H-14b), 1.29 (1H, H-4'b), 0.92 (3H, H-15).

^{13}C NMR (500 MHz; $CDCl_3/\delta$) = 141.5, 140.8, 114,5, 114.1 (aminopiridin), 105.4 (C-1'), 75.3 (C-3), 69.9 (C-5'), 68.9 (C-2') 64.6 (C-3') 44.7 (C-2), 39.6 (3'-$N(CH_3)_2$), 20.9 (C-14), 29.9 (C-4'), 10.4 (C-15).

MS (ES^+) m/z (%) = 852.

Example 11

5-*O*-Desosaminyl-9-deoxo-9-dihydro-9a-N-{N'-[4-(3,4-dimethyl-3--isoxazolylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithronolide A

Analogously to the process disclosed in Example 3, from 1.15 g (2.0 mmol) 5-*O*--desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A, 0.43 g (2.0 mmol) 4--(chlorosulfonyl)phenyl isocyanate and 0.45 g (4.0 mmol) 5-amino-3,4--dimethylisoxazole in 30 ml dry toluene 0.75 g pure 5-*O*-desosaminyl-9-deoxo-9--dihydro-9a-N-{N'-[4-(3,4-dimethyl-3-isoxazolylaminosulfonyl)phenyl]carbamoyl}-9a--aza-9a-homoerithronolide A was obtained with following spectral data.

MS (ES^+) m/z (%) = 870.

Example 12

5-*O*-Desosaminyl-9-deoxo-9-dihydro-9a-N-{N'-[4-(5-methyl-3--isoxazolylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithronolide A

Analogously to the process disclosed in Example 3, from 1.15 g (2.0 mmol) 5-*O*--desosaminyl-9-deoxo-9-dihydro-9a-aza-9a-homoerithronolide A, 0.43 g (2.0 mmol) 4--(chlorosulfonyl)phenyl isocyanate and 0.39 g (4.0 mmol) 3-amino-5-methylisoxazole in 30 ml dry toluene 0.7 g pure 5-*O*-desosaminyl-9-deoxo-9-dihydro-9a-N-{N'-[4-(5-

-methyl-3-isoxazolylaminosulfonyl)phenyl]carbamoyl}-9a-aza-9a-homoerithronolide A was obtained with following spectral data.

^{1}H NMR (500 MHz; $CDCl_3/\delta$) = 4.36 (1H, H-1'), 3.87 (1H, H-3), 3.56 (1H, H-5'), 3.32 (1H, H-2'), 2.65 (1H, H-2), 2.48 (1H, H-3'), 2.32 (6H, 3'-$N(CH_3)_2$), 1.95 (1H, H-14a), 1.70 (1H, H-4'a), 1.55 (1H, H-14b), 1.30 (1H, H-4'b), 0.90 (3H, H-15).

^{13}C NMR (500 MHz; $CDCl_3/\delta$) =105.6 (C-1'), 74.6 (C-3), 69 (C-5'), 69.3 (C-2') 64.6 (C-3') 44 (C-2), 40.1 (3'-$N(CH_3)_2$), 21.4 (C-14), 30.2 (C-4'), 10.8 (C-15).

MS (ES^+) m/z (%) = 856.